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DEVELOPING MATRIX MODULES AT MATHEMATICS EDUCATION FACULTY OF TEACHING AND EDUCATION UIN SUSKA RIAU

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Abstract

This research aimed to develop modules containing valid, practical, and effective matrix materials in Linear Algebra? at Mathematics Education Department, Faculty of Teacher Education UIN Suska Riau. The research findings showed that teaching materials and instruments were valid, practical and effective. It was found that the matrix materials modules could be used by the students without much difficulty in the sense it was practical and effective in use that could be seen from their learning activities and their high motivation after teaching and learning process. This research could be developed by using various active learning strategies and the modules could be learned by the students at home to economize lecturing time.

Keywords: Development, module, matrix

Introduction

Background

The advancement of technology eases people of doing their everyday activities including in the area of education. In educational setting technology is an area that covers the application of complex and integrated process in analyzing and solving educational problems (Yusufhadi Miarso, 1986. p. 5), meaning that with technology a student could easily access various sources of information in order to solve the problems relating to what he or she is learning. To help students understand the teaching materials a teacher should provide them with learning sources, among others by designing learning modules which are suitable and effective. To make a lecture effective the students need to be facilitated in order to be able to understand the materials being presented. This is because "in general students are already mature in thinking and making a choice compared with the time when they were in senior high school" (Hisyam, 2004, p. 4). Therefore, they should be treated in the manners that are suited to their characteristics as they are

already adult. According to Erman (2004) adults are normally able to direct themselves; they already have various experiences; and are prepared to learn because they know that learning is their need and they enjoy doing activities that are problem centered (p.75). Besides, every student is an individual who has potential for self-learning through written sources, mass media or their environment. In this respect, the lecturer has a role as a facilitator who creates conducive learning atmosphere so that the students' potential could develop in maximum.

At university level students should be directed to student centered learning in order to understand and analyze problems facilitated by the lecturer through a workbook in order to help them to study continuously. However, the workbook is not designed to substitute the reference book or a lecture (Martono, 1991, p.i). This idea is supported by Strang (1991) who argues that a workbook is designed to teach Maths in a more effective and directive way so that the students can study more systematically. So far, the teaching of Linear Algebra at Mathematics Education UIN Suska in particular is not yet effective because the number of references is large and heterogeneous. Moreover, there have been no practical materials provided by the lecturers for the students; consequently, it is difficult to achieve active teaching and learning process.

On the other hand, modules are the compilations of materials taken from guidebooks and banks of questions that have been compiled in such a way and gradually designed to improve the students' skills and understanding on the steps of answering the questions. The designed modules for Linear Algebra contain matrix that are used to help the students deal with the matrix as the basis of Linear Algebra subject.

Learning by using a modular system has a number of strengths among others:

a. It focuses on the individual students' ability because they basically possess the ability to work on their own and are more responsible for what they do.
b. There is a control towards students' learning achievement through the use of competency standard in each module to be achieved by the students.
c. There is relevancy of the curriculum indicated by the learning goals and the ways the materials are presented so that the students know the relevancy between the teaching and learning process and the results to be achieved.

However, the modular system also has a number of limitations as follows:

a. A good module needs special expertise in the sense that its success or failure depends very much on its design.
b. It is difficult to determine the schedule and the passing process as modules require the management which is very different from conventional learning because every student completes the modules in different times depending on their speed and ability.
c. The learning sources are generally expensive as the students have to find them individually.

Nevertheless, the limitation of using modules could be minimized by validating the instruments and sharing ideas with some lecturers in order to

improve the quality of the modules before distributing them to the students to be used in Linear Algebra subject.

Theoritical Reviews

Learning module is a unit of the smallest teaching and learning program, which is studied by the students themselves as individuals or taught by the student himself (self-instructional) (Winkel, 2009). Vembriarto (1987:20), states that a learning module is a package that contains one unit of teaching concepts rather than materials. Teaching is a business module held individual instruction that allows students to master a unit of lessons before she turned to the next unit. Based on some understanding of the modules above it can be concluded that the learning module is one forms of teaching materials designed according to the material and packaged in a systematic and attractive so easy to learn independently by students. Learning module is one of the learning materials that can be used by students independently. Both modules must be compiled systematically, interesting, and clear. Modules can be used anytime and anywhere according to the needs of students.

The characteristics of the learning modules (Anwar, 2010) as follows:

1. Self instructional, students are able to learn themselves, not depend on others.
2. Self contained, whole learning materials from one unit of competency are studied contained in one complete module.
3. Stand alone module that was developed does not depend on other media or should not be used in conjunction with other media.
4. Adaptive, adaptive power module should have a high regard for the development of science and technology.
5. User friendly, Modules should also meet the rules familiar friendly / familiar with the wearer.
6. Consistency, Consistency in the use of fonts, spacing, and layout

Moreover, according to Wijaya (1988), the characteristics of teaching learning modules are:

a. Students can learn individually, he studies with the maximum active without the help of the teacher.
b. Specifically formulated learning goals. Formulation of goals rooted in changes in behavior.
c. Objectives formulated specifically to behavioral changes that happen to students immediately known. Behavioral changes are expected to complete 75% mastery (mastery learning)
d. Open up the opportunity for students to advance sustainable according to their capabilities.
e. Module is a teaching package that is self-instruction, with this learning, the module opens the opportunity for students to develop themselves optimally.

f. Power modules have enough information. Element associations, structure, and sequence of learning materials are formed in such a way that students learn spontaneously.
g. Module provides many opportunities for students to do active.

Learning to use the module should also be planning activities. The following planning learning activities modular implementation:

1. matrix module shared slowest learners week before learning.
2. Cooperative learning model based on constructivist learning activity which centered on students.
3. At the end of each learning unit made quiz.
4. Test results and students' task done corrected and returned with a structured feed back, at least before the next teaching learning material units.
5. Provide the opportunity for learners who can not successfully mastered the material taught on a short quiz.

Research Methodology

This research was development research consisting of three stages:

Front-end analysis

This stage was taken in order to get a picture of the condition in the field through the following steps:

1. Performing peer- interviews
2. Analyzing Linear Algebra syllabus
3. Analyzing Linear Algebra text books
4. Reviewing the literature on matrix modules and development research methodology.

The teaching and learning process should encourage the students to work effectively and individually by providing them with certain modules to make them easy to read references and to unite their perceptions in understanding the matrix.

Prototype

The results of the Front end-analysis were used to design a matrix module prototype in Linear Algebra subject, Lesson Plan, interview guidelines, questionnaires on motivation and observation sheets on students' learning activities. This prototype was made in two stages, that is; validity stage and practicality stage.

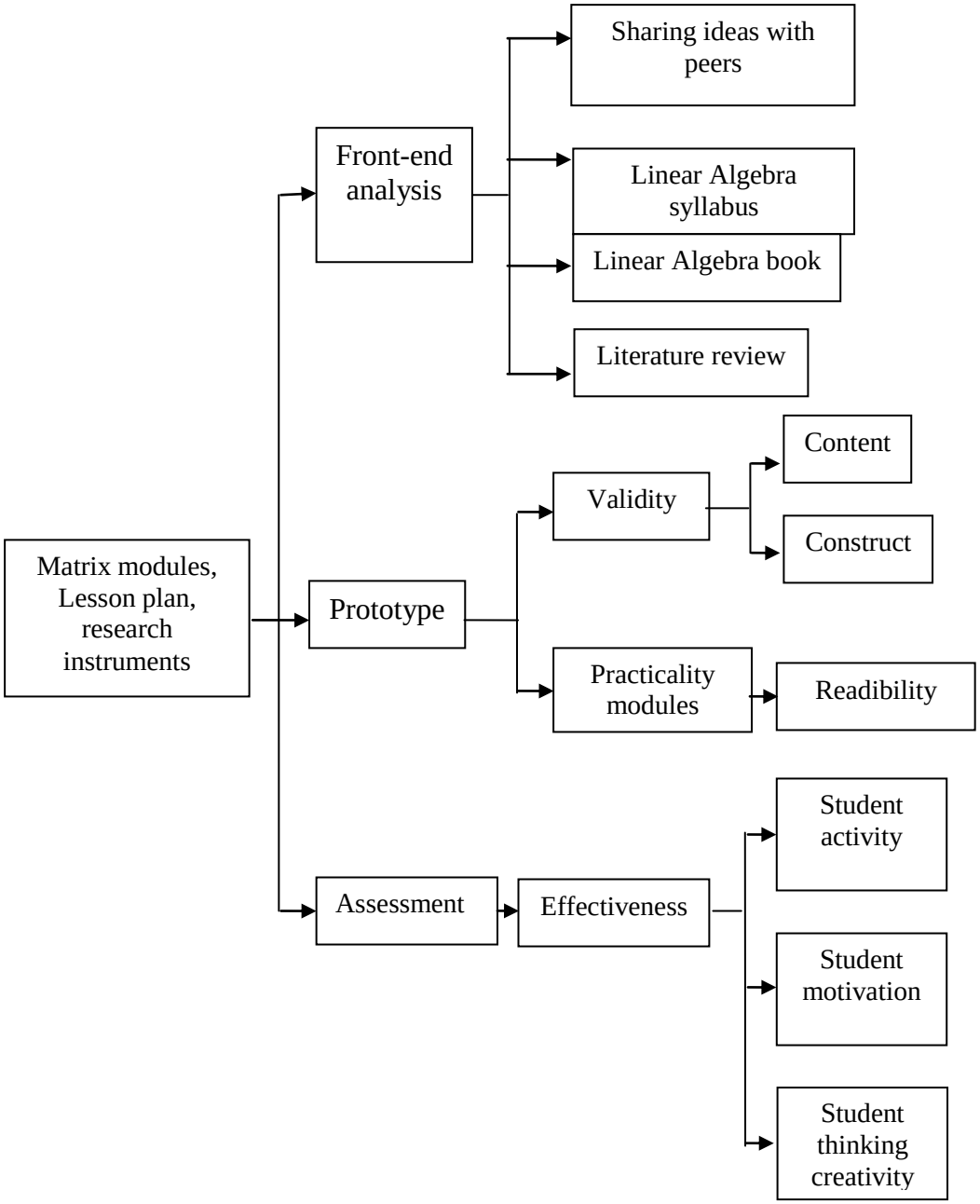
1. Validity stage
   There are two kinds of validity used in the work book, i.e. content validity, the designed the matrix modules suits the subject taught and the construct validity, the suitability of the matrix module components with the determined indicators.

2. Practicality stage
   At this stage a try-out was performed limited to Class D which was intended to see the practicality or the use of the workbook designed by the lecturers and students in class. The components to be researched are presented in Table 1.

Table 1
Constructivism-based work book practicality

1.1. ***1.2. No.***	***1.3. Aspects***	***1.4. Data collection methods***	***1.5.*** ***1.6. Instruments***
1.7. a)	*1.8. Teaching and learning process using matrix module*	*1.9. Class observasions*	*1.10. Observation sheets*
1.11. b)	*1.12. Direction*	*1.13. Interview with students*	*1.14. Interview guide*
1.15. c)	*1.16. Contents*		
1.17. d)	*1.18. Time*		

Assessment
At this stage the activity was focused on evaluating whether the prototype (the try-out version) could be used effectively as expected to improve quality and students' learning achievement. The effectiveness aspect observed in the teaching and learning process using the matrix modules in the try-out class was the student activity and their learning motivation. The stages of the research undertaken are presented in the following diagram.



Research Findings

1. Lesson Plan validity, research instrument.

The Lesson Plan validity could be seen from the validity sheet recapitulation average score from the experts, i.e. the Lesson Plan with very valid category of 88, 19%. The interview guide designed by the researcher was very valid with the score of 87, 50%, while the learning activity and motivation questionnaire were valid with the validity score of 87, 50% and 89, 58% respectively.

2. Matrix modules validity

The content of the matrix module are as follows:

a. The main materials consisted of the materials presented for the sub-chapter.

b. The competency indicators were developed from the basic competency contained in the subject syllabus based on Linear Algebra text books. The competency indicators contained the goals to be achieved by the students after using the matrix modules.
c. The material summary was taken from the Linear Algebra text book by Howard Anton and Roress, Mathematics book for secondary and High school by Sartono Wirodikromo. The material summary could be used as the basic knowledge by the students.
d. Assignments containing question items that require students' deep thinking. The assignment could only be answered if the students have mastered the teaching materials. Assignments could encourage the students' creativity.
e. Guided exercises containing question items already arranged from the low to high difficult level. Every question had an incomplete answer. The guided exercises were taken from a book by Howard Anton and Roress, Mathematics book for secondary and High school by Sartono Wirodikromo that match the students' ability. By doing the guided exercises the students were expected to get self-study experience. Every guided exercise had a direction to complete.
f. Exercises along with answer keys containing question items that have higher difficulty level compared with the guided exercises. The exercises items were also taken from the same sources. Through these exercises the students could develop the answers by themselves on the basis of their new understanding when completing the guided exercises. Every exercise had a direction to complete.
g. Conclusions seemed to be the results of the student constructions towards the materials already learned. The students were asked to write a summary using their own language.

The validity results from the validators showed that the matrix modules that had been developed for Linear Algebra was already valid. It means that the modules had assessed what to be assessed based on the competency formulated in the syllabus. The validity modules could be seen from both content validity and construct validity. The results of the matrix modules are presented in the following table:

Table 2
The validitry results of constuctivism-based workbook

Aspects	Scores					Average
	0	1	2	3	4	
1	**2**	**3**	**4**	**5**	**6**	**7**
Formulation of competency indicators				1	2	3,67
What to achieve in competency indicators				2	1	3,33
Ability contained in competency indicators				2	1	3,33
1	**2**	**3**	**4**	**5**	**6**	**7**
Number of indicators related to time				2	1	3,33
Characteristics of instruments				2	1	3,33
Ability to motivate				2	1	3,33
Benefits on the part of students				1	2	3,67
Theories employed				1	2	3,67

Question items used				2	1	3,33
Divergent answers	2	1				0,33
Question items variation				3		3
Question items that encourage the students to think				2	1	3,33
Summary of materials could be used as the initial knowledge				1	2	3,67
Able to give self-learning experience to the students				1	2	3,67
Guided execises could help the students construct their knowledge				1	2	3,67
Assignments encourage thinking creativity				2	1	3,33
Gives chances to the students to construct their owm knowledge				1	2	3,67
Encourage interactions				1	2	3,67
Aims and materials					3	4
Materials and questions				1	2	3,67
Sentences				2	1	3,33
Level of difficulty				3		3
Shape				2	1	3,33
Form of cover				2	1	3,33
Probability to make modifications				1	2	3,67
Average						3,35

The above table shows that according to the mean Likert score results by validator module validation matrix was 3.35, with a very valid criteria the ctiteria of being *very valid*.

3. Matrix modules practicality

The result of the try-out administered for the fourth semester of Class D totaling 38 regular students of Mathematics Education Faculty of teaching and education UIN Suska Riau indicated that the matrix modules were practical, interesting and beneficial to the students. Unless the time given to complete the questions was not enough. Based on the results of the interview with the students discovered that the students knew how to fill in the questions in the modules and they felt that it was easy for them to understand the teaching materials. According to them the question items in the modules were varied ranging from easy questions to difficult ones, whereas the time required to fill in the workbook was different depending on the learning condition at a time. Also, the constraints being faced by the lecturers and students could be solved through the use of other learning strategies that were not time-consuming.

4. Matrix module effectiveness

The matrix modules for Linear Algebra were tried-out through cooperative learning strategy using *jigsaw* where the students' activities and their learning

motivation were obtained. It was found out that the score of the students' answers to learning motivation questionnaire was 2282. Based on the interpretation criteria table on student learning motivation it was discovered that the level of student motivation after using the matrix modules was categorized very high.

a. Students activities

To know the effectiveness of matrix module towards students' activities observations were carried out. Paul B. Diedrich in Sardima (2007) offer eight kinds of activity taking place in learning, i.e. Visual activities, Oral activities, Listening activities, Writing activities, Drawing activities, Motor activities, Mental activities, and Emotional activities (p.101). Observations made on the students' activities during teaching and learning process showed that the matrix modules could encourage students to do positive activities and could minimize their negative activities. Their positive activities were in the form of answering question items completely, asking friends, answering friends' questions, giving opinions, comparing friends' answers and their own, discussing with partners. But the most dominant activity they did in class was comparing their answers with their friends'. Besides, discussing with friends was other activity that was frequently done in class. They made use of this activity to discuss unfinished items with friends. Low ability students could ask higher ability students to solve problems being encountered. On the other hand, negative activities that could be minimized were talking and day dreaming. The latter seldom happened as the students were busy filling in the module and asking their partners and listening to the explanation from other group that was making a presentation in front of the class and asking them questions. Talking to each other tended to happen when the group presenting was writing answers on the whiteboard. Those who were talking were usually the same persons and they were low ability level students.

b. Student learning motivation

To ascertain the effectiveness of the matrix modules towards student learning motivation, they were asked to complete a set questionnaire on learning motivation. Keller (1983) argues that there are four categories of motivational condition that should be borne in mind by the lecturers in an effort to have an interesting class, meaningful and challenging to the students (1) interest, (2) relevance, (3) expectancy, (4) satisfaction (p.389). This questionnaire was completed at the end of the semester. What follows is information about student motivation after they used the matrix module for Linear Algebra: (1) Interest to answer question items contained in the matrix modules. The students did not have much interest in asking and answering questions and giving suggestions when group discussions were in progress which was also noticeable when the lecture was taking place. Only very few of them who were asking, answering questions and giving suggestions. Nearly half of the students' number said that they were motivated in learning because when they were dealing with the question items to answer they were already provided with the steps to answer the questions. Good students felt that they were challenged to answer the questions with answer keys. (2) Relevance of the matrix modules with the teaching materials. The students said

that the question items in the modules usually matched the materials given in class. The module suited the students' need and ability so that the question items in the module were easy to understand. (3) Students expected that they would have good achievement after they learned by using the modular system and therefore, they studied seriously in order to gain better results. (4) Satisfaction, somebody would be motivated if the work he is going to do would lead him success. This could happen to the students as well in the sense that they would be satisfied and motivated if his module has been completed. Those with good behaviour are normally present in every meeting and are seldom lazy when a lecture is going on. Besides, the students' satisfaction after filling in the workbook would tell us whether or not they understand the material being presented in class.

c. Creative thinking

Interviews were conducted in order to know the effectiveness of the matrix modules towards the student creative thinking. Torrance (1969) described four creativity components that are accessible:

(1) Fluency, the ability to produce some ideas.
(2) Flexibility, the ability to create various ideas.
(3) Elaboration, the ability to develop or express an idea.
(4) Originality, the ability to produce ideas which are not common in everyday life.

Interviews contained questions available in the modules already taken by the students and the interviews were performed in random. There are positive points that could be gained from the interviews:

a) The students were able to answer questions spontaneously and fluently after reading the questions. They were also able to explain the way to answer the questions from the beginning to the end.
b) Their flexibility was noticeable when they related the answers to pictures or matrix.

Conclusions

Conclusions

The resulting matrix module valid, practical useness, and effectiveness. Lesson Plan is used, interview guides, questionnaires and observation sheets motivation Uncategorized valid student activities, to the effectiveness of the activity observed matrix modules, learning motivation, and creative thinking of students. The result is a book for Linear Algebra matrix module is able to activate students especially those who are low-ability. While the motivation of students after the lecture with module for Linear Algebra matrix is very high.

Findings

Validator assessment results to guide the matrix module based on the highest percentage of any aspect stated as follows: The purpose of the lecture is formulated in a very clear indicator of visible competence, rational matrix module book is for the benefit of students.

The contents of the workbook is used in accordance with the theory, the characteristic matrix module is a summary of the material can be used as the initial knowledge. Matrix module can provide their own learning experience for students. Guided exercises to help students construct knowledge. Matrix module provides opportunities for students to construct their own knowledge and bring better interaction between students and lecturers and students with students. Conformity between objectives seem to matter, the use of language in the workbook shown in a simple and clear sentences. Physical form workbook very interesting in terms of packaging and cover, this matrix module provides the possibility to be modified.

Suggestions

These matrix modules can be further expanded by using the application of a various active learning strategies, in the classroom. In addition, the use of matrix module should have begun learned at home by students in order to save more time lecturing. Because the tests carried out only in limited trials in one class, then try at can be developed at various university classes or different characteristics.

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